possible to say how much or how little may be achieved. The system of warfare is entirely new, and the introduction of steam also materially alters the tactics of war. I can, however, assure you that I will—and I know the officers and crews with me will—do everything in my power to uphold the honour of the country and its navy. We will do our duty to the best of our ability, and I am sure I shall ever remember the kindness of the people of Portsmouth. (Loud cheers.)

Sir Charles Napier then left the Hall, amid the renewed plaudits of those present.

Becher's Mercurial Marine Artificial Horizon.

H.M. Surveying vessel *Fairy*, at Woolwich,
November, 26th, 1834.

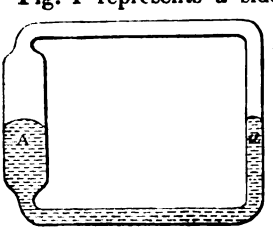
Sir,—My Lords Commissioners of the Admiralty having been pleased, by your letter of the 2nd September last, to direct me to give a trial to a Marine Artificial Horizon invented by Lieut. A. B. Becher, I beg, herewith, to forward the following report thereof for their lordships' information.

The contrivance proposed by Lieut. Becher for a Marine Artificial Horizon consists of a rectangular shaped tube of glass containing a small quantity of mercury, and it is by means of the two surfaces of this mercury in the opposite parts of the tube, to which there is an uninterrupted communication, that Lieut. Becher finds the place of the horizon.

The principle which Lieut. Becher has adopted, namely, that a fluid when unobstructed will always find its own level, is a well known law in hydraulics; but there are certain conditions to be observed in its application to the sextant, as a substitute for the horizon, that his experience in the use of that instrument has not failed to suggest to him; and, although, I am informed, the same principle has before been applied to the same instrument for the same purpose, it is due to Lieut. Becher to state that it has not been treated with the same judgement, and, therefore, not with equal success.

The annexed sketches of the instrument proposed by Lieut. Becher will assist in its description.

Fig. 1 represents a side view of the tube, the lines A and *a* the surfaces of the mercury in the lower part of the tube. The passage of the mercury to all parts of the tube being unobstructed, it is evident that the surfaces A and *a* will be on the same level whatever may be the position of the tube, and *in theory* the plane of these two surfaces must be assumed as horizontal. In its application to the sextant, it is required to place the eye in this



plane at the moment of observation; or, in other words, to ascertian when the surface *a* is on the same level as the surface A, and at the same instant to observe the altitude.

Fig. 2. is a diagonal representation of the tube, and shows the manner in which the opposite extremities of it are shaped so as to arrive at the condition necessary for observation. The part A of the tube is widened so that the surface of the mercury may be extended across the plane at right angles to the line of sight; and the opposite part *a*, nearest to the eye, is divided into two lesser ones, but each forming a portion of the same rectangular one, as represented in the sketch. By this arrangement the condition above mentioned is obtained.

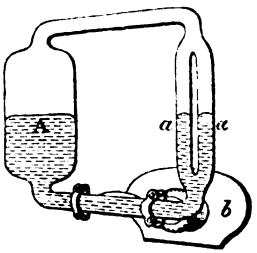


Fig. 2.

The plane of the surfaces is readily found by their being seen in contact, as shown in fig. 3., and, at the same time, this judicious distribution of the various parts of the tube is such as not to interfere with the observation.

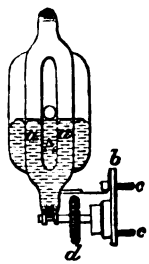


Fig. 3.

Such being the general arrangement of the tube for the purpose of forming an artificial horizon, Lieut. Becher has attached it to the sextant (fig. 4.) so that the horizon glass comes between the enlarged part A and the smaller parts *a a*, (the latter being nearest the eye,) and its plane parallel to the plane of the sextant. And, also, while the sextant is held in the vertical position for observation, the two surfaces of the mercury A, *a a*, are as near as possible in the axis of the observing tube of the sextant. The tube forming the artificial horizon is fitted to a metal collar *b*, figs. 2 and 3, with feet *c c*, fig. 3, which are received in sockets in the frame of the sextant, and is readily secured in its place by means of a small screw *d*, fig. 3, by which arrangement it can be attached or detached in three or four seconds of time and does not interfere in any manner with the adjustments of the instrument.

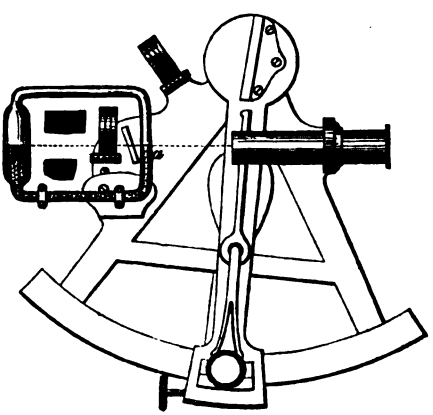


Fig. 4.

The sextant, with its marine artificial horizon, being thus prepared for observation, the business of the observer is to hold it so that the two surfaces of the mercury shall be exactly in the line of sight from

the eye end of the observing tube of the sextant. The sun, when brought down in the usual way, passes from the index glass between the smaller tubes *a a*, and is seen again reflected in the horizon glass at ⊙, fig. 3, while the farther surface of the mercury A is seen beyond it. The two surfaces of the mercury and the sun's limb must necessarily be in contact at the same instant of time to insure a correct observation.

In measuring the altitude of a heavenly body above the horizon by any reflecting instrument, it is necessary that the plane of reflection should be at right angles to the plane of the horizon. This is found in practice with the natural horizon by the observer turning his instrument a little right and left, the axis of the telescope being that of motion, and it is only when the horizon forms a tangent to the arc which the above named movements cause the deflected image of the sun to describe that a true observation can be made. The same will be found with the marine artificial horizon under consideration. If the plane be not at right angles to the plane of the horizon at the instant of bringing down the sun's limb the observed altitude will be always in excess, and will be shown to be so by the reflected image dipping, on giving the instrument the above-mentioned movement on the axis of the telescope.

It may now be proper to observe that although the plane of the surfaces of the mercury in the tubes has been assumed as horizontal, yet that in practice it is not so. This arises from the capillary depression of the small tubes, and produces an error varying according to their diameters. This error in the particular instrument now reported upon was found to be $+3°$ nearly, and was readily found by comparing a series of simultaneous observations with it and the common artificial horizon, on terra firma; but as it is a constant quantity in the same instrument, this circumstance does not in any way militate against the efficiency of the invention.

In the course of the numerous observations which I have made with Lieut. Becher's horizon in the North Sea, and under the various circumstances of violent and gentle motion, I have invariably found it more sensitive than seems necessary to this motion. In other words, the rising and falling of the mercury in the smaller tubes, owing to the difficulty on the part of the observer to obviate this effect of the motion of the vessel on the mercury, renders it difficult in great motion to preserve the level of the two surfaces in the line of sight. This may arise from the disproportion between the capacity of the two small tubes *a a* and the opposite enlarged part A of the horizon; or it may partly arise from the peculiar form and diameter of the lower and connecting part of the tube, the latter being perhaps larger than is necessary for its purpose.

Hence, the sensitiveness of the horizon, which was found to operate against an observation in proportion to the motions of the vessel, might be remedied by the inventor, by increasing the capacity of the small tubes *a a*, so that they may contain together a quantity of mercury equal to that contained in the larger tube A. Also, by contract-

ing the diameter of the lower and connecting tube, and gently curving it at the same time, so as to obtain a free and uninterrupted and, at the same time, smooth and regular movement.

Whether the whole or a portion of these suggestions be adopted by Lieut. Becher, the principle on which he has proceeded remains the same. The mercury, under any circumstances has always fair and easy access to any part of the tube, and will be in no way affected by the small portion of atmospheric air in the upper part of it. Some of the above-mentioned observations have agreed with those taken with the natural horizon at the same instant of time; the former with the error of the instrument applied, the latter divested of dip. Others have differed several minutes of a degree,—in some instances as far as fifteen,—but this seems to depend on the quantity of motion.

Considering Lieut. Becher's marine artificial horizon in its present condition, there are circumstances in which the seaman is sometimes placed when it would not only be very desirable, but might, perhaps, prove the means of saving him from shipwreck. It frequently happens that, owing to fog and haze, the horizon of the sea is not visible when an observation at noon could be obtained if it were so; and, in the knowledge of seamen there are many instances in which a ship homeward bound has been unable to run for the English Channel, because, owing to fog, she has been unable to obtain an observation for latitude. And there can be no doubt, but on some such occasions, the means afforded by Lieut. Becher's horizon would have produced a latitude within such limits as would have allowed the ship, by a timely notice of the errors in her dead reckoning, not only to shape a Channel course, but perhaps save her from destruction. On the coasts and neighbourhood of Nova Scotia and Newfoundland, where the prevalence of fogs is so great, and the action of the currents so uncertain, there can be equally no doubt that frequent occasion would present itself for the employment of Lieut. Becher's horizon with great advantage.

During my survey of the North Sea, I have experienced very many instances of fog, when the stem was not visible from the stern of the vessel; at the same time, on account of the thinness of the stratum of fog, the sun was perfectly well defined, and the approach of vessels to each other was discoverable only from their respective mast-heads. It is on such occasions as those above enumerated in which this horizon would prove eminently useful.

The invention of Lieut. Becher, although expressly intended as a marine artificial horizon, is also available to the traveller, to whose baggage it would prove a far less cumbrous appendage than the artificial horizon commonly in use. The results obtained from it on shore, freed as it would be from the motion of the ship, would perhaps be sufficiently near the truth to determine the positions of places; in addition to which it would come into use when the common artificial horizon, in consequence of the required angle to be observed being double the altitude, would be entirely useless, by surpassing the limits of the sextant. Such instances would commonly occur in tropical

climates and in places where the altitude to be observed should much exceed 60°.

Having, in the foregoing statement, shown that the invention of Lieut. Becher is available for the purposes of observation under the circumstances and within the limits mentioned, which limits will also depend as to their minuteness on the skill and expertness of the observer, as all observations must do; and having also shown that for the purposes of the traveller by land the instrument may be used with a still greater degree of precision, it remains only for me to add that such an invention is well worthy the high patronage and support of their lordships, and that to Lieut. Becher may justly be ascribed the honour of having first placed in the hands of his brother seamen an instrument which, even in its present unimproved condition, may be considered as comprehending the nearest approximation to that long acknowledged and great desideratum in navigation, a "Marine Artificial Horizon."

I have the honour to be, &c.,

WM. HEWETT, Commander.

The Secretary of the Admiralty, London.

Should any portions of the above report appear imperfect to their lordships, I beg to add that both the inventor and the instrument being in their Lordships' hydrographical office, their presence can be commanded by their lordships on the instant.

[The foregoing report seems to have been lying by, in some measure owing to the greater success which attended the Pendulum Horizon invented immediately afterwards, and an account of observations with which have appeared in these volumes since 1838 and its description in that of 1841;—an instrument which is now in use among those of our seamen who, as Captain Beechey observes, "have a quick eye and an expert hand."* With reference to the late Captain Hewett's remark on that before us, he readily acknowledged afterwards the advantage of always having the larger body of mercury in the further part of the tube, as it gives the observer the advantage of commanding always a *steady* well defined edge, to which he has to bring the level of the mercury in the two little tubes nearer to him to complete his horizon for observation, and thus has only one part of his horizon to attend to instead of two. Good mercury (not always to be had) and clean tubes for a fair flow, a tolerably steady hand, and a moderate sea are all that are necessary in using this instrument, which is now introduced into the *Nautical Magazine* with the view of establishing that claim to it on the part of the inventor which belongs to him alone. It has been made at different periods since its invention and its manufacture is now followed up very successfully by Mr. Whitbread of Grenada Terrace, Commercial Road, while the Pendulum Horizon is made by Carey, Dennis, and several other opticians.]

* *Description of the Pendulum Artificial Horizon for Day or Night invented by A. B. Becher*, p. 18.—Potter, Poultry.